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REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED

REVISION

OWNER:

塔尔煤田一区块发电有限公司
THAR COAL BLOCK-1 POWER GENERATION COMPANY(PVT)LTD

EPC CONTRACTOR:

上海电气
SHANGHAI ELECTRIC

上海电气集团股份有限公司
SHANGHAI ELECTRIC GROUP CO., LTD
上海电气香港有限公司
SHANGHAI ELECTRIC HONGKONG CO., LIMITED
上海电气工程设计有限公司
SHANGHAI ELECTRIC ENGINEERING CONSULTING CO.,LTD

DESIGN:

CEEC
中国能建
ENERGY CHINA
CGGC

杭州华源前线能源设备有限公司
HANGZHOU RUNPAQ ENERGY EQUIPMENT CO., LTD

PROJECT:
巴基斯坦塔尔煤田一区块2x660MW燃煤电站项目
A NEW 2 x 660 MW MINE-MOUTH COAL-FIRED POWER GENERATION PLANT AT THAR BLOCK-I,
SINDH, THE ISLAMIC REPUBLIC OF PAKISTAN

DESIGN STAGE:
施工图设计
Detail Design

APPROVED		CHECKED	
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启动锅炉说明书

AUXILIARY BOILER MANUAL

DRAWING No.	2001SM	REV	A

前 言

Foreword

非常感谢您购买我司制造销售的 SZS 型燃油启动锅炉。本产品是我公司研制开发的新一代环保型、节能型产品。它具有热效率高、操作简便等优点。但如果安装、使用、维护不当，不但不能充分发挥该产品的优良性能，反而可能出现危险。

Thank you very much for purchasing our oil-fired steam boiler, the new generation environment-friendly and energy efficient product we have developed, which is characterized by high thermal efficiency and easy operation. However, in the event that the boiler is not properly installed and used, danger may even occur, not to mention the normal performance it is due to have.

因此，在安装、使用该产品前请认真阅读本说明书、配套的燃烧器等辅机说明书！

Therefore, prior to installation and use of this product, this manual and the instructions of auxiliary units like the burner must be observed.

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Ⅰ、设计说明

I. Description of Design

为了缩短电厂建设周期，确保安装进度，我司引进国外先进技术，开发了第二代快装式（整装式）启动锅炉。锅炉受热面全部在工厂内组装完成，现场只需安装相关的平台、扶梯、保温、外包装、管道、阀门、仪表等即可，大大减轻了现场的安装工作量，缩短了安装周期。锅炉可以采用雨棚式室外布置的形式不仅可以防止雨水的侵蚀,而且大大降低了建筑成本。当然也可以室内布置。

To shorten the power plant construction cycle and ensure the installation schedule, we have developed the second-generation package start-up boiler by introducing in the advanced technologies. Since the heating surface of boiler and its components are assembled in the factory, only the platform, ladder, insulation facilities, external packaging, pipelines and ducts, valves, and instruments have to be separately installed at the user’s site, which not only cuts done the workload for site installation but also shortens the installation cycle. The boiler can be provided with canopy for outdoor application to prevent rainwater corrosion and make the construction cost more efficient. Of course, indoor application is also permissible.

同时为了减轻运行人员的操作强度，锅炉运行也可以做到一键启停。

Meanwhile, to lessen the operator’s workload, the boiler can also be started or stopped by pressing only one key during operation.

一、锅炉规范

i. Specifications for Boiler

1、设计参数表

1. Table of Designed Parameters

序号 No.	名　称 Name	单 位 Unit	数 据 Value
一、　主要参数 Main Parameters			
1	锅炉型号 Boiler Model	SZS50-1.3/350-Y	
2	额定蒸发量 Rated Evaporation Capacity	t/h	50
3	额定蒸汽压力 Rated Steam Pressure	MPa	1.3
4	额定蒸汽温度	℃	350

	Rated Steam Temperature		
5	给水温度 Feed Water Temperature	℃	20
6	进风温度 Air Intake Temperature		20
7	排烟温度 Fume Temperature	℃	<160
8	锅炉设计效率 Boiler Designed Efficiency	%	92.9
9	燃烧方式 Combustion Method		室燃 Chamber Burning
10	燃料消耗量 Fuel Consumption	kg/h	4018
二、	**设计燃料 Designed Fuel**		
1	低位发热值 Low Calorific Value	kJ/kg	41264
三、	**水质要求 Water Quality Requirement**		
1	标准 Criterion		按照 GB/T1576-2008《工业锅炉水质》accord with GB/T1576-2008 *Water quality for industrial boilers*
四、	**主要尺寸要求 Requirements on Main Dimensions**		
1	锅炉外形尺寸 Boiler External Dimension	mm	13500x8100x4665
2	最大件运输尺寸 Maximum Dimension for Transportation	mm	12900x4200x4165 13500x2720x4350
3	锅炉有效水容积 Effective Water Volume of Boiler	m^3	25（运行状态下） 25 (in working mode)
4	锅炉满水容积 Full Water Volume of Boiler	m^3	31.5（水压试验状态下） 31.5(under hydraulic test)

2. 安全门参数表

2. Table of safety valve parameters

序号 No.	名　称 Name	工作压力 Working Pressure MPa	整定压力 Set Pressure MPa	回座压力 Return Pressure MPa	备注 Remark
1	上汽包安全门 1 Steam-drum safety valve 1	1.5	1.59	1.48~1.51	
2	上汽包安全门 2 Steam-drum safety valve 2	1.5	1.59	1.48~1.51	
3	过热器安全门 Super-heater safety valve	1.3	1.352	1.25~1.28	

3. 运行整定参数表

3. Table of operating and setting parameters

序号 No.	项目 Item		设定值 Set Value	备注 Remarks
1	汽包压力保护值 Drum pressure protective value		1.52 MPa	MFT 并报警 MFT and alarming
2	紧急排空电动门动作压力 Operating pressure of emergency exhaust electric valve		开启：1.32 MPa 关闭：1.25 MPa On: 1.32 MPa Off: 1.25 Mpa	
3	炉膛压力保护值 Furnace chamber pressure protection		+3500Pa	MFT 并报警 MFT and alarming
4	过热蒸汽温度调节值 Super-heated steam temperature for regulation		350（±20℃）	PID 自动调节 PID Automatic Regulation
5	上锅筒水位设定 Water Level Setting of Steam Drum	H 最高安全水位 H-highest security water level	+50mm	报警 Alarming
		N 正常水位 N-Normal water level	0 mm	
		L 最低安全水位 L-Low water level	-50mm	报警 Alarming
6	给水箱水位设定 Water Level Setting of Feed-water Tank	H 高水位 H-High water level	+2800mm	报警 Alarming
		L 低水位 L-Low water level	+1200mm	报警 Alarming
		LL 低低水位 LL-Low low water level	+500mm	停给水泵 Stop feed-water pump

二、结构简介

ii. Brief Introduction to Structure

SZS50 启动锅炉形式为双锅筒纵置式 D 型结构，为便于运输，炉体分成两大模块：炉膛模块和对流管束模块，两大模块均采用了密封性能可靠、承压能力高的全膜式水冷壁结构形式，分别安装在各自的钢底架上。两大模块之间通过高温烟气连接管连接而成，现场安装简便。

SZS50 is in the form of double drum boiler vertical type D structure, is easy to transport, the boiler body is divided into two modules: the furnace module and the convection tube bundle module, two modules are the reliable sealing performance, high pressure bearing capacity of the whole membrane water wall structure, were installed in the steel frame. The two modules are connected by a high temperature flue gas connecting duct, it is easy installation on site.

炉膛模块为燃料高温燃烧区域，由炉膛上、下集箱通过膜式壁连接而成，前墙布置有燃烧器，四周布置了高温吸热面，炉膛尾部设置了高温烟气出口窗。对流管束模块后部设置了对应的高温烟气进口窗，并在该区域布置了水平式过热器（采用与烟气逆流方式布置）。模块前部设置了对流管束，烟气为“之字型”横向冲刷对流管束。对流管束模块由上下汽包通过对流管束连接而成，外侧采用膜式壁。对流管束模块的烟气出口与逆流布置的省煤器连接，烟气横向冲刷省煤器受热面管束后由烟囱排出。

The furnace module is a fuel high temperature combustion region, which is formed by connecting the furnace upper and the lower header and the membrane wall, The front wall is provided with a burner, a high temperature heat absorbing surface is arranged on the periphery, and a high temperature flue gas outlet window is arranged at the tail part of the furnace. The corresponding high temperature flue gas inlet window is arranged at the rear part of the convection tube bundle module, and in the regional layout of the level of superheater (with flue gas countercurrent arrangement). The convection tubes is arranged in front of the module, the flue gas as the "zigzag" cross flow convection bank. The convection tube bundle module is formed by the connection of the steam and the water drum through the convection tube bundle. The flue gas outlet of the convection tube bundle module is connected with the economizer arranged in the reverse direction, the flue gas is transversely washed the economizer heating surface and exhausted from the chimney.

两大模块之间的汽水系统由 10 根汽连管和 10 根水连管组成，炉膛模块中的上集箱通过汽连管与对流管束模块的上汽包连接，炉膛区域的高温汽水上升后通过汽连管流到上汽包，经汽水分离装置分离成蒸汽和水，蒸汽汇集到汽包上部流入过热器；“低温”水经对流管束模块的管束往下流经下汽包、水连管流入炉膛模块的中间下集箱，经炉膛模块加热后形成“高温”汽水并上升，如此形成水循环系统。

The steam and water system of the two modules is connected with 10 steam pipes and 10 water pipes, the upper header of the furnace module is connected with the steam drum of the convection tube bundle module by a steam pipe. The high temperature water steam in the furnace area rises and flows to the steam drum through the steam pipe, Separation of steam and water by steam water separator, steam collection into drum upper to superheater. Low temperature water flows down to water drum through connection tube bundle module and lower header of furnace through water connecting pipes, and then heated by furnace module, formed to high temperature steam water and rise to upper header, so that the steam water circulation system is formed.

本锅炉采用微正压通风方式。

The boiler uses the micro-positive pressure ventilation.

（1）锅筒及内部装置（具体尺寸与锅炉压力等参数有关）

(1) Boiler Drum & Internal Devices (Its specific dimension is concerned with parameters like boiler pressure)

锅炉上锅筒内径为Φ1100，壁厚为18mm，下锅筒内径为Φ900，壁厚为16 mm，均采用Q245R钢板卷制而成。上锅筒装有监控水位的平衡容器、电接点水位计、差压变送器，以及就地显示液位的水位计，并设置有连续排污、加药、气体保护等管座。上锅筒上还装有两只弹簧式安全阀、压力表，以及锅炉超压保护用的压力控制器等。正常水位一般设置在上锅筒中心线处，最高及最低水位分别位于正常水位±50mm处。同时在上锅筒内还设置有合理有效的汽水分离装置，在蒸发强度大的水冷壁上升管处装设了缝隙挡板、波纹板，对流管束区域设置了水下孔板，并在主蒸汽出口处设置了不锈钢丝网分离器。下锅筒设三个锅筒支座，两个滑动支座，一个固定支座。锅炉膨胀中心设置在下锅筒中间的固定支座处，

The internal diameter and wall thickness of the steam drum are Φ1100 and 18mm, respectively, while these two values for the water drum are Φ900 and 16mm, respectively. Both of them are rolled up by using Q245R steel plate. The steam drum is provided with equilibrium container that monitors the water level, the electric-point hydrological gauge, differential pressure transmitter, and the hydrological gauge that indicates the local liquid level, as well as the tube holders for continuous blow-down, chemical dosing, gas protection, and so on. There are also two spring-loaded pressure relief valves, pressure gauge, and the pressure control used for boiler overpressure protection on the steam drum. Normal water level is usually set at the center line of the steam drum, and the HH and LL water levels are located at places respectively 50mm over and below the normal level. Meanwhile, the steam drum has steam-water separator, baffle plate and corrugated plate on the riser tube of water wall where there is more evaporation, the water hole plate in the convection bank zone, and stainless-steel mesh separator at the main steam outlet. The lower drum is provided with three boiler supports, i.e. two sliding supports, and one fixed support. The boiler expansion center is just located on the fixed support in the middle of the water drum.

（2）水冷系统

(2) Water Cooling System

水冷系统由炉膛区、对流区两部分组成，炉膛区由炉膛上、下集箱、前后水冷壁及侧膜式水冷壁组成，其中前后水冷壁上下集箱分别与炉膛上下集箱连通；对流区由上下锅筒、对流管束、对流管前膜式壁、对流管侧膜式壁等组成。炉膛区与对流区之间由汽、水连管相连，其中汽连管两端分别与炉膛上集箱及上锅筒连接，水连管两端分别与炉膛下集箱及下锅筒连接。炉膛区膜式水冷壁管子规格为Φ60×4，

管子材料为 20（GB3087）；对流区膜式水冷壁规格为 Φ51×4，对流管束管子规格为 Φ51×3，管子材料为 20（GB3087）。

The water-cooling system is composed of the furnace and convection modules. The furnace module is consisting of upper header, lower header, front and rear water-cooling wall and left and right membrane walls. In which, the upper and lower header of front and rear water-cooling wall are connected with the upper and lower header of furnace. The convection module is consisting of steam drum, water drum, convection tubes bundle, and the front, side, and rear membrane walls. The steam and water pipes are used for connection between the furnace module and the convection module, in which, the two ends of the steam connecting pipe are respectively connected with the upper header of furnace and the steam drum, the two ends of the water connection pipe are respectively connected with the lower header of furnace and the water drum. The furnace membrane walls are made up of Φ60×4 tubes, the material is 20（GB3087）. The convection membrane walls are made up of Φ51×4 tubes, the convection tubes size is Φ51×3, and their materials are 20(GB3087).

（3）过热器

(3) Super-heater

过热器布置在对流管束入口处，采用单级水平布置方式，由 Φ42×3.5 的 12Cr1MoVG 管子组成，蒸汽由进口集箱进入过热器蛇形管，再到出口集箱。经喷水减温调节蒸汽温度后进入汇流集箱。

Super-heater is located at the inlet of convection bank and arranged in horizontal single-stage structure. It consists of Φ42x3.5 12Cr1MoVG tubes. The steam flows into the multiloop super-heater from the inlet header and then out into the outlet header. When the steam temperature is decreased by the water sprinkling, the condensate flows into the collector.

（4）省煤器

(4) Coal Economizer

省煤器设计成可分式的单独结构，采用高效传热的螺旋鳍片管，管子采用 Φ32x3.5 的无缝钢管。

Economizer is designed to be the sectional separate structure, and made up of highly efficient heat-transfer spiral finned tubes which are the Φ32x3.5 seamless steel tubes

（5）燃烧系统

(5) Combustion System

燃烧器采用分体式燃烧器，水平布置于前墙。燃烧器配备了高能点火装置、火焰检测装置，以及用于负荷调节的风门执行器、油量调节阀等。为了确保点火的可靠性和安全性，专门设置了点火油枪（耗

油量约在 200kg/h），保证锅炉点火的成功率，以及避免点火时产生爆燃等突变现象。锅炉燃烧排放符合 GB13271-2014《锅炉大气污染物排放标准》的要求。

The burner adopts a split burner which is horizontally arranged on the front wall. The burner is provided with high-energy ignition device, flame detector, and air damper actuator and oil control valve responsible for relevant load adjustment. To ensure the ignition reliability and safety, the burner is particularly provided with ignition oil gun (its oil consumption is about 200kg/h) to guarantee the boiler ignition success and prevent unexpected phenomenon like explosion. Boiler’s emission resulting from the combustion conforms to provisions of GB13271-2014 *Criteria for Air Pollutant Emission of Boiler*.

（6）炉墙

(6) Chamber Wall

本锅炉采用安装简便的轻型炉墙，使用的绝热材料主要有：硅酸铝纤维板、耐火混凝土、耐火砖等。

The boiler uses light-weight chamber wall that is easy and convenient for installation and the thermal insulating materials it uses mainly include the alumina silica fiber plate, refractory concrete, and fire bricks.

（7）平台扶梯

(7) Platform Ladder

本锅炉在需要频繁操作、监测、检修的部位均设置了操作平台和相关的连接扶梯。平台和连接扶梯符合 GB4053.3《固定式工业防护栏杆安全技术条件》的要求。

The boiler is provided with operating platform and relevant connecting ladders at the place that may require frequent operations, monitoring, and inspection and repairs. The platform and connecting ladder conform to GB4053.3 *Safety Requirements for Fixed Industrial Protective Railings*.

（8）其它相关附件：

(8) Other Relevant Accessories:

锅炉炉膛上设置了检修人孔、观察孔、防爆门、炉膛风压测点及风压保护开关，炉膛出口及相关受热面的出口均设置了温度检测点。蒸汽/热水侧也设置了相关的压力、温度测点，便于运行控制和安全保护。

The furnace chamber is provided with access manhole, observation hole, explosion door, measuring point for chamber’s air pressure, and air pressure protection switch. The chamber’s exit and the exits of related heating surfaces are all provided with temperature monitoring points. Places for steam/hot water are also provided with related pressure and temperature measuring points, for the purpose of operating control and safety protection.

三、锅炉运行参数

iii. Boiler Operational Parameters

1. 各部件热力计算总表：

1. Summary of Heat Calculations of All Parts

序号 No.	项目 Item	符号 Symbol	单位 Unit	炉膛 Furnace	过热器 Super Heater	对流管束 Convection Bank	省煤器 Economizer
1	管径及壁厚 Tube Dia.& Wall Thickness	d×δ	mm	Φ60×4	Φ42×3.5	Φ51×3	Φ32×3.5
2	进口烟温 Inlet Fume Temperature	θ'	℃		1112	840	383
3	出口烟温 Outlet Fume Temperature	θ"	℃	1112	840	383	155
4	进口工温 Inlet Working Temperature	t'	℃	201.4	201.4	201.4	20
5	出口工温 Outlet Working Temperature	t"	℃	201.4	350	201.4	105
6	烟气流速 Fume Velocity	W_y	m/s		29.8	13	19.5
7	传热系数 Heat Transmission Coefficient	k	$W/m^2.℃$		101.4	60.3	46
8	燃料消耗量 Fuel Consumption	B	kg/h		4018		
9	锅炉设计热效率 Designed Thermal Efficiency of Boiler	η	%		92.9		

2.锅炉烟风阻力参数：

2. Drag Parameters of Boiler’s Fume & Air

锅炉烟（空）气阻力（不包括燃烧器） Resistance of Boiler’s Fume and Air (excluding the burner)	Pa	2585
烟气量（～ 155 ℃） Flue Gas Volume (about 160 ℃)	m^3/h	83352
空气量（20℃） Air Capacity (20℃)	m^3/h	52972

3.过热器壁温：

3. Super-heater Wall Temperature

过热器管材质采用的 12Cr1MoVG，其最高使用温度范围为 580℃，经过炉内热负荷过热器区域的强度情况来看：进口处烟温最高处其壁温 516℃，出口处烟温最高处其壁温为 432℃。壁温均小于 580℃，合格。

The super-heater tubing uses 12Cr1MoVG, whose maximum permissible temperature is 580℃. In the view of thermal load intensity in super-heater zone, the highest wall temperatures for inlet fume and outlet fume are 516 ℃ and 432 ℃, respectively, which are all below 580℃.

Ⅱ、安装说明

II. Instructions for Installation

一、安装前准备

i. Pre-installation Preparations

锅炉安装前必须做好下列准备工作：

The following jobs should be achieved before boiler installation:

1、安装使用登记手续请参照当地技术监督部门的有关规定。

1. For boiler installation and operation registration procedures, please refer to regulations set forth by local technical and supervision department

2、安装单位必须持有技术监督部门颁发的相应级别安装许可证且在有效期内方可担任施工任务。

2. The contractor responsible for installation should not undertake any boiler construction until it has obtained the installation license of the level corresponding to the boiler to be installed issued by the technical and supervision department concerned during the term of license validity.

3、安装前应认真查阅锅炉技术性文件，严格按照相关标准和产品图纸有关技术要求进行安装。

3. Technical documents of the specific boiler should be read through carefully before installation, and the boiler should be installed in strict line with technical requirements set forth in relevant standards and drawings.

4、安装地点的确定：

4. Determination of Installation Location:

（1）锅炉房的布置应符合 GB50041-2008《锅炉房设计规范》中的规定，且布局要合理、美观。

(1) The boiler house should be laid out properly and pleasantly in conformity with provisions of GB50041-2008 *Code for Design of Boiler Houses*.

（2）消防通道应畅通，给水和排污要合理。

(2) Fire passages should be kept free of any obstacles, and the water supply and blow-down systems should be properly designed.

（3）燃料的存放要安全，取用要方便。

(3) Fuel should be stored safely and convenient for access.

（4）本体安装地点最好能接近蒸汽使用地点，以便缩短蒸汽输送管路，减少管路散热损失，降低基本建设费用。

(4) It is recommended that the boiler body be located in the vicinity of the site of steam use so as to shorten the steam pipeline, reduce pipeline thermal loss, and cut down the infrastructure construction costs

5、检查安装所需的配件以及采购材料是否齐全，规格型号是否符合标准要求（特别要注意计量仪表的计量单位）。

5. The accessories and purchased materials necessary for installation should be checked for their completeness and conformity of models and specifications with the standards (particularly the measurement units of meters and gauges).

二、本体安装

ii. Boiler Body Installation

锅炉安装中对各部件的要求，应按 GB50273《工业锅炉安装工程施工及验收技术规范》要求执行。若因锅炉超宽超高无法整体运输的，须进行现场组装。

The requirements for each part during boiler installation should be carried out in accordance with GB50273 *Technical Codes for Construction and Acceptance of Industrial Boiler Installation Engineering*. Where the boiler is unable to be transported as a whole due to extra width or height, it should be assembled at the construction site.

现将一些要注意的事项申述如下：

Aspects that should be noted are stated as follows:

1、根据锅炉、锅炉房设计图纸、技术文件并对照锅炉图纸的要求，校验锅炉土建基础的正确性。

1. Correctness of the boiler’s foundation should be reviewed and verified in accordance with the design drawings (for boiler and boiler house) and technical documents, and by referring to the boiler’s drawings.

2、根据炉体重量，准备好吊装工具，吊装就位后炉体应符合图纸要求。

2. The hoisting tool should be provided in accordance with the boiler body weight. When the hoisting tool is put in place, the boiler body should be placed as required by the drawing

3、检查锅炉底脚与基础面接触是否良好，如有空隙加垫铁片使锅炉保持受力均匀。

3. Check if the boiler footings are well contacted with the ground surface. Where there is any gap, iron plate can be used under the footing to give the boiler uniform stress.

4、烟道法兰连接处均应采用硅酸铝绳等，使各接头密封严密，以防泄露。烟囱吊装应保持铅垂度、直线度和图纸要求。

4. Flue flange should be wound with alumina-silicate rope at the connection to seal all the joints and prevent leakage. The stack that is to be hoisted should be kept vertical and linear, and as required by drawings.

5、安装燃烧器应严格按照燃烧器制造单位提供的技术资料和说明进行；燃料管路及电气线路的安装应符合锅炉房设计规定及有关规范如《锅炉安全监察规程》和消防安全方面等规定进行。

5. The burner should be installed strictly in compliance with the technical information and instructions provided by the burner manufacturer; the combustion ducts and electric wiring should conform to boiler house

design and relevant specifications such as the Specifications for Safety Supervision of Boiler and fire protection requirements.

6、热工仪表、阀门和管道的组装。

6. Assembly of thermodynamic instruments, valves and pipelines and ducts.

7、安全阀应在水压试验后安装，安装必须垂直，并应连接排放管引至安全处。

7. The relief valve should be installed vertically after the hydraulic test, and led to safe place after connecting with the discharge pipe.

8、安装压力表时，应使刻度盘垂直，压力表刻度盘上应画出红线，以示锅炉最高许可工作压力，压力表旋塞旋转要灵活，不得漏水，存水管应通畅。

8. When the pressure gauge is to be mounted on, its dial should be held vertical and drawn with a red line to indicate the boiler’s highest permissible working pressure. The gauge faucet should be agile and with no leakage, and the disconnection trap should be maintained free of obstacles.

9、由合格操作人员连接总电源进线（此线为三相四线，AC400/220V ±10%），为确保安全，锅炉本体应接地线连接，对地电阻应小于 10Ω。

9. The main power lead-in line (three-phase four-wire line, AC400/220V±10%) should be connected by the qualified electrician. To ensure the safety, the resistance to ground should be less than 1Ω when the boiler body is grounded.

10、燃料贮存罐应设置在便于观察又符合消防要求的地方。

10. The fuel storage tank should be installed at the place that is accessible for observation and conforms to fire protection requirements

11、根据有关标准和要求，将燃料供应管路、水路、电路等全部接通后，准备水压试验。

11. When the fuel supply pipe, water pipeline and circuits are all connected up in accordance with relevant standards and requirements, the hydraulic test then can be started

12、在总体验收前应对供汽、进气及给水管路进行安装后吹扫，以避免管路氧化皮等杂质进入过滤器。

12. Pipelines for steam supply, gas supply and feed water should be purged after installation before the overall acceptance so as to prevent contaminants like pipeline oxide skin getting into the filter.

三、烘炉（暖炉）

iii. Furnace Drying (Furnace Heating)

新安装锅炉和连续停用 3 个月以上都应进行烘炉（暖炉）；

The new boiler and the boiler that has not been used for the past three months or above should be dried in the furnace;

1、烘炉前的准备工作

1. Preparations before Furnace Drying

编制烘炉方案及烘炉曲线，对参加人员进行技术交底，并准备好有关烘炉记录。炉墙上布置好测温点或取样点，并准备好温度计或取样工具。

Furnace drying plan and curve should be prepared; and all participants involved should be trained and take a good note of all records about the drying. The chamber wall should be furnished with points for temperature measurement or sampling, and provided with thermometer or sampling appliances.

2、烘炉

2. Furnace Drying

本锅炉采用火焰烘炉法进行烘炉，其中前期为开火种阀小火烘炉，后期~12.5%燃烧器负荷烘炉。

This boiler adopts flame drying method, in which the furnace is dried at mild fire during earlier and transitional stages, and at about 12.5% of the burner’s load at the final stage.

前期烘炉阶段（小火）：点燃燃烧器小火，根据升温的情况调整火焰的大小，根据各测点显示数据，然后逐渐加大火焰，以过热器后部的烟气温度为监控调节值。

Furnace Drying at Earlier Stage (mild fire): Ignite the burner’s mild fire. Regulate the flame shape relative to temperature rise. Then increase the blaze according to display data of each measuring point and take the fume temperature at the tail of the super-heater as the value for regulation.

后期烘炉阶段（~12.5%燃烧器负荷）：当用小火已不能使过热器后温度再提高的时候（一般为 2-3 天）应加大燃料投入量烘炉，逐步增大送风量，加强燃烧，使烟气温度不断提高。

Furnace Drying at Final Stage (about 12.5% of the burner’s load): When the super-heater is unable to reach higher temperature by mild fire (this usually takes 2-3 days), more fuel should be fed into the furnace, and deliver the input air gradually, intensifying the combustion and increasing the fume temperature.

3、烘炉时间的温度控制

3. Time and Temperature Control of Furnace Drying

烘炉期间，控制温度很重要，升温的速度对烘炉的效果有着直接影响，因此，采用测量过热器后部的烟气温度的办法来控制燃料供给量及送风量。

During furnace drying, temperature control is very critical, and the heating-up rate plays a direct role on drying effects. Therefore, by measuring the fume temperature at the tail of the super-heater, the fuel feeding and air input rate can then be controlled.

第一天温升不得超过 50℃，以后每天升温不得超过 30℃，每小时不得超过 10℃，烘炉后期，烟温不得超过 220℃。在最高温度范围内，烘炉持续时间不得少于 24 小时。如果炉墙特别潮湿应适当减慢温升速度。

Temperature rise on the first day should not exceed 50℃, and the temperature rise per day and per hour for subsequent days should not exceed 30℃ and 10 ℃ respectively. At the final drying stage, the fume temperature should not exceed 220℃. Within the highest temperature vicinity, the drying duration should not be less than 24 hours. Where the chamber wall is especially damp, heating-up rate should be appropriately slowed down.

4、控制燃烧火焰

4. Combustion Flame Control

烘炉时燃烧要均匀，按时记录温度读数，并且要注意观察炉体膨胀情况和炉墙情况，以便出现异常时及时处理。

During furnace drying, the combustion should be maintained uniform. The temperature readings should be recorded on schedule, and the furnace body expansion and the chamber wall should not be watched carefully for their changes and be properly handled in case of atypical conditions.

5、及时排出水蒸汽

5. Timely Discharge of Water Vapor

为了及时排出烘炉期间产生的水蒸汽，在烘炉时，应打开上部检查门，当发现炉墙的温度比较大时，还应减缓升温速度并加强通风，以便使炉墙中的水分及时蒸发并顺利排出。

To discharge the water vapor generated during furnace drying betimes, the upper access door should be opened during drying. Where chamber wall has a higher temperature, the heating-up rate should be slowed down and the ventilation should be enhanced so that the moisture inside the chamber wall can be evaporated and discharged as soon as possible.

6、烘炉时间

6. Furnace Drying Time

烘炉时间一般为 5-7 天，究竟多少天数适宜，要根据炉墙的具体情况，当时当地的气候条件等因素具体确定。

The time for furnace drying is usually 5-7 days, depending on specific chamber wall and local weather.

7、烘炉的合格标准

7. Standards for Acceptable Furnace Drying

7.1 炉墙经烘烤后不应有变形和裂纹，混凝土不得有塌落等缺陷。

7.1 There should not be distortion and cracks on the furnace wall nor concrete slump after the firing.

7.2 凡达到下列规定中任一种标准时，即认为达到合格。

7.2 It is considered as acceptable when one of the following standards is met.

7.2.1 炉墙灰浆试样法

7.2.1 Chamber Wall Mortar Sampling

在过热器位置的炉墙中部、下部位置分别取耐火砖的丁字交叉缝处的灰浆 50g，若其含水率小于 2.5%，则为合格。

Sample 50g of mortar respectively from the T-shaped joints of fire bricks in the middle and lower parts of the furnace wall where the super-heater is located. If the water content is less than 2.5%, it is deemed as acceptable.

7.2.2 测温法

7.2.2 Temperature Measurement

在过热器炉墙耐火砖与隔热层接合处设测温点，而当此点的温度达到 50℃时，并继续保持 48 小时。

Set a point at the joint of super-heater chamber wall fire bricks and heat-insulation layer for temperature measurement. When the temperature at this point reaches 50°C and maintains for the subsequent 48hours, it is deemed as acceptable.

用测温法烘炉时，要定期观察测点的温度，做好记录，并给出温升曲线，存入锅炉技术档案中。

Where temperature measurement method is used for furnace drying, the measuring point should be watched on a regular basis for record and temperature rise curve. All these data should be preserved in boiler technical archives.

四、煮炉

iv. Boiling-out

煮炉在烘炉结束后进行，煮炉目的就是要清除锅炉受热面内表面的油污及铁锈等杂质，保证锅炉炉水品质，确保锅炉在安全、经济工况下正常运行。本锅炉的煮炉采用氢氧化钠（NaOH）和 磷酸三钠（$Na_3PO_4.12H_2O$），其加药量均为 2-3 公斤/每吨锅水，配制成~20%的均匀溶液加入锅内，不得将药品直接加入锅炉。

Boiling-out procedure is carried out following furnace drying, whose purpose is to clean boiler’s internal heating surface and remove the oil stains and rusts, and ensure its water quality and boiler operating in safe and economic conditions. For boiler boiling out, NaOH and $Na_3PO_4.12H_2O$ are used as the additive, whose dose should be 2-3 kilos for every ton of water. The chemical should not be added into the boiler directly. Instead, it should be made into the solution with a concentration of 20% first.

1、煮炉前的准备

1. Preparations before Boiling Out

1.1 人员及工器具准备

1.1 Preparations Required for Personnel and Necessary Apparatus

参加煮炉的人员确定之后，要明确分工，使之熟悉煮炉要点，在煮炉之前，要将胶手套，防护眼镜、口罩等防护用品准备齐全。操作地点应有清水，急救药品和纱布，以备急用。

When the personnel are determined for the boiling-out, their obligations should be specified so as to grasp the key points of boiling-out procedure. Before the procedure is started, they should put on rubber gloves, protective goggles, and masks. The site for boiling-out operations should be provided with clean water, first-aid medicine, and gauze for emergency use.

1.2 药品准备

1.2 Additive Solution Preparation

准备 150kg 氢氧化钠（NaOH）和 200kg 磷酸三钠（$Na_3PO_4.12H_2O$），将其中 65kg 氢氧化钠（NaOH）和 85kg 磷酸三钠（$Na_3PO_4.12H_2O$）加 400kg 水溶解，配制成浓度为~20%的药液。

Prepare 150kg NaOH and 200kg $Na_3PO_4.12H_2O$ in total, take out 65kg and 85 kg respectively, and add 400kg water. Then the solution with 20% content is ready for use.

2、煮炉的方法及要求

2. Boiling-out Method & Requirements

2.1 烘炉末期，当炉墙红砖灰浆的含水率降至 10%以下，或当过热器耐火砖外侧温度达到 50℃时，即可进行煮炉。

2.1 When the water content in the motor of chamber wall common brick is reduced to 10% or below or when the outside temperature of super-heater fire brick reaches 50℃ at the final stage of furnace drying, boiling-out procedure can then be carried out.

2.2 向锅炉内加药

2.2 Add the Solution into the Boiler

锅炉处在最低水位时，通过上锅筒加药管路系统一次性加入配制成的浓度为~20%的药液。

When the boiler has the water at the minimum level, pour the solution with about 20% content into the steam drum through dosing pipe system.

2.3 煮炉时间及压力要求

2.3 Requirements for Boiling-out Time & Pressure

2.3.1 加药后升压到 0.3～0.4MPa 左右，要保持 4h，并在此压力下煮炉 12h,并紧固全部人孔、手孔、阀门等。

2.3.1 After chemical feed, the pressure should be increased to 0.4-0.4MPa and maintained for 4h, and the boiling-out procedure should be carried out in this pressure for 12h. During boiling-out, all the manhole, hand-hole, and valves should be closely shut down.

2.3.2 继续加热升压到 0.8MPa，煮炉 12h,并注意锅炉的运行情况。

2.3.2 Continue the heating-up cycle until the pressure reaches 0.8MPa, and boil the furnace in this pressure for 12h. Special attention should be given to boiler operations.

2.3.3 在 1.2MPa 压力下，煮炉 12h，如发现问题，待降压后再作处理。

2.3.3 In 1.2MPa pressure, boil the furnace for 12h. In case of any problem, it should be handled after the pressure drops.

2.3.4 压力降至 0.3～0.4MPa 加水，保持压力，堵炉 4h。

2.3.4 Add water when the pressure drops to 0.3-0.4MPa, maintain this pressure and boil the furnace for 4h.

2.4 取样化验

2.4 Sampling & Assay

煮炉期间应不断地进行炉水取样试验，如碱度低于 45 毫克当量/升时应及时补药。

During furnace boiling-out, continual water samplings and assays are required. Where the alkalinity is lower than 45mg/l, chemical should be added.

2.5 降压排污

2.5 Pressure Drop & Blow-down

煮炉期间，需要排污，应将压力降低。

When draining is required during boiling-out procedure, the pressure should be reduced.

2.6 换水、清洗及检查

2.6 Water Change, Purging & Inspection

煮炉结束后，应放掉碱水，清除锅筒、集箱内的沉积物，冲洗炉内和曾与药物接触的阀门等，检查排污阀有无堵塞。

After boiling-out, the aqueous alkali should be drained, and the buildups inside the boiler drum and header should be removed. The furnace and all the valves contacting with the chemicals should be flushed. Check the blow-down valve for any blockage.

3、煮炉合格标准

3. Standards for Acceptable Boiling-Out

3.1 锅筒、集箱内壁无油垢。

3.1 Check the internal walls of the boiler drum and header, and make sure there is no oil stain.

3.2 擦去附着物后，金属表面应无锈斑。

3.2 Wipe away the deposit builders and make sure there is no rust on the metal surface.

4、煮炉中应注意的事项

4. Notes & Notices during Boiling-out

4.1 煮炉期间，锅炉应保持在最高水位，以保证被清洗部分浸满洗液，同时，注意不允许让药液进入过

热器，过热器吹洗和主蒸汽管道一起进行，药液在过热器存留时间较长，对其腐蚀较严重。

4.1 During boiling-out, the boiler should maintain the HH water level to ensure that the proportion of furnace to be cleaned is submerged in the solution. Meanwhile, special attention should be given to preventing the chemical solution from getting into the super-heater. Super-heater should be purged along with the main steam ducts. If the chemical solution stays a longer time in the super-heater, it may cause serious corrosion.

4.2 在煮炉后期，压力已达工作压力的 75%，此时要注意检查各部的变化情况，膨胀情况，特别要注意检查锅筒，受热面管子，膨胀节，支吊架，炉墙与锅筒，集箱的接触部位等。

4.2 At the final stage of boiling-out when the actual pressure has reached 75% of the working pressure, internal changes and physical expansions of each part should be inspected, particularly the boiler drum, heating surface tubes, expansion joints, hanging and supporting brackets, and the contacting parts between chamber wall, boiler drum and header.

4.3 煮炉期间，应经常检查，受压元件，管道、风烟道的密封情况。

4.3 During boiling-out, regular inspections should be given to the pressure elements, pipelines, and air/fume ducts for their seal.

4.4 煮炉期间，前后、左右应对称地进行排污。

4.4 During boiling-out, the drainage should be carried out in a symmetrical way where the front and rear, and the right and left should be blown down symmetrically.

煮炉结束后，各管道系统应按要求进行吹扫冲洗。具体参照 DL5190.2—2012《电力建设施工技术规范 第 2 部分:锅炉机组》和 DL5190.5-2012《电力建设施工技术规范第 5 管道及系统》。

After the boiling-out procedure, each duct/pipeline system should be purged and flushed as required. For detailed operation, refer to DL/T5190.2-2012 *Technical Specification for Thermal Power Erection and Construction Part 2: Boiler Unit* and DL5190.5-2012 *Technical Specification for Thermal Power Erection and Construction Part 5: Piping and System.*

五、总体验收

iv. Overall Acceptance

1、锅炉总体验收时，使用单位应报告当地技术监督部门，消防、环保、安装等有关部门派员参加。经总体验收合格，领取当地锅炉压力容器安全监察机关核发的使用许可证，方可投入运行。用户应根据锅炉的数量和对安全性能的要求，设置专门机构和专职人员，加强对锅炉安全技术管理，建立和健全安全管理制度。

1. When the boiler is going to be inspected for overall acceptance, the user should report to local technical and supervision department, and the inspection should be done with the presence of persons appointed by fire

protection department, environment department and installation contractor. When the boiler is qualified after the inspection, the user should obtain the operation license issued by local Boiler & Pressure Vessel Safety Supervision Institute before the boiler is put into official operation. The user should set up a department and appoint the qualified personnel, based upon the number of boilers and the requirements for safety and performance, to intensify the technical control of boiler safety, establish and improve the safety control system

2、使用单位对锅炉的运行，必须按照有关规定实行定期检查、保养，并做好其检查、保养情况的记录。

2. During operation, the user should make regular inspection, maintenance and repairs in accordance with relevant regulations, and take records of inspection and maintenance.

Ⅲ、锅炉运行操作

III. Boiler Running & Operating

本锅炉的启动运行应遵照 **JB/T10354-2002《工业锅炉运行规程》**的有关规定进行。

The starting and operating of this boiler should conform to relevant regulations of **JB/T10354-2002** ***Specifications for Industrial Boiler Operation*.**

一、基本要求

i. Basic Requirements

1、人员落实：根据工作岗位落实人员。

1. Personnel: The relevant personnel should be appointed and trained according to the job description.

2、巡视锅炉、辅机及各接点的外观情况。

2. The external conditions of the boiler, auxiliary machines and all connections should be inspected during patrol.

3、电系统的检查：各电气连线是否正常？电机设备转动方向是否正确？

3. Check the electric system whether the electric wiring is correctly set out and whether the motor revolves in the right direction.

4、给水系统的检查：

4. Feed Water System Inspection:

（1）给水系统是否有水，压力情况是否正常，供水是否正常。给水的联系电话及人员落实情况。

(1) Check if the feed water system has water; the pressure is in normal range; the water is properly fed; relevant contact information is updated; and the person appointed for such post is properly fulfilling his/her obligations.

（2）给水系统的阀门检查，进出水阀门需在开的位置；电动调节阀是否正常；再循环管及水泵再循环管阀门的位置；给水压力表指示是否正常。

(2) Inspect the feed water system valves, and make sure the feed-water/drain valves are turned on. Check if the electric control valve is normal, valves on the re-circulating pipes and water pump re-circulating pipes are turned to right positions, and the feed-water pressure gauge operates alright.

（3）给水泵冷却水是否正常通畅，阀门是否在开的位置。

(3) Check if the feed-water pump provides cooling water smoothly and the valve is turned on.

（4）给水泵点动试转，检查转动方向是否正确、有无异常现象。

(4) During the crawl test of feed-water pump, check if the turning direction is right and there’s any abnormality.

5、燃烧系统检查：

5. Combustion System Inspection:

（1）给油系统是否有油，压力情况是否正常，供油是否正常。给油的联系电话及人员落实情况

(1) Check if oil-feeding system has any oil; the pressure is in normal range; the fuel is properly fed; relevant contact information is updated; and the person appointed for such post is properly fulfilling his/her obligations.

（2）给油系统阀门须在开的位置。

(2) Make sure that valves of oil-feeding system are turned on.

（3）燃烧器送风机点动试转，检查转动方向是否正确、有无异常现象。

(3) During the crawl test of draught blower of the burner, check if the turning direction is right and if there’s any abnormality.

（4）火焰检测装置是否干净、正常。

(4) Check if the flame detector is kept clean and normal.

（5）锅炉运行油系统是否连接可靠，进回油压力是否符合要求。油管路连接手动阀门应处于开的位置。

(5) Check if the fuel system is reliably connected and inlet/return oil pressure conform to relevant requirements. Manual valve connected with the oil system through pipelines should be turned on.

6、锅炉安全附件的检查：

6. Inspection of Boiler’s Safety Accessories:

（1）各位置压力表指示是否符合要求，阀门需在开的位置。

(1) Check if the indications of all pressure gauges conform to relevant requirements. Valve should be turned on.

（2）水位计显示面是否清洁，阀门应通畅灵活。汽水连通管路阀门应处于全开位置，疏水阀门应处于全关位置。

(2) Check if the display screen of the hydraulic gauge is kept clean and the valves can be turned freely, without any blockage. The valve mounted on the steam-water connecting pipeline should be turned on to full extent; so should be the steam trap.

（3）安全阀、泄放阀有无异常，疏水管是否通畅。

(3) Check if the relief valve and drain valve are normal, and the drain pipe is free of blockages.

（4）水位计、差压变送器显示是否正常。

(4) Check if the hydraulic gauge and differential pressure transmitter are alright.

（5）压力传感器、压力控制器接线是否正常。

(5) Check if the pressure sensor and pressure control are correctly connected.

（6）各温度点的温度计接线是否正常。

(6) Check if the temperature gauge wiring on each temperature measuring point is normal.

（7）烟气通道压力表是否正常，炉膛微压变送器接线是否正常。

(7) Check if the pressure gauge inside the fume duct and the chamber micro-pressure transmitter’s wiring are alright.

7、汽水管道检查：

7. Inspection of Steam-water Pipes

（1）各排污、疏水、紧急放水、加药管道阀门是否正常且在关的位置，管道是否通畅。

(1) Check if all the valves mounted on pipelines for blow-down, drain, emergency drain, and chemical solution addition are turned on and the pipelines are free of blockages.

（2）放空管道是否通畅，阀门且在开的位置。

(2) Check if purge pipeline are free of blockages and relevant valves are turned on.

（3）主蒸汽阀门、蒸汽流量计是否正常。

(3) Check if the main steam valve and steam flow meter are in normal state.

（4）并汽网络系统是否正常、并汽的联系电话，人员的落实。

(4) Check if the network that brings the boiler onto a line is in normal state, relevant contact information is updated; and the person appointed for such post is properly fulfilling his/her obligations.

8、受热面的检查：

8. Inspection of Heating Surface:

（1）炉膛、过热器、省煤器、对流管束内是否有异物。

(1) Check if there is any alien inside the furnace chamber, super-heater, coal economizer, and convection bank.

（2）各检查门防爆门是否关闭密封。

(2) Check if the access door and explosion door are closely sealed.

9、其它：

9. Others:

平台、扶梯、栏杆应完好畅通；照明设备应完好；消防设备应齐全并处于正常状态；工作场地和设备周围通道应清洁、畅通。

The platform, ladder and handrails should be intact and free of obstacles; the lighting appliance be in good state; the fire-fighting equipments be completed and in normal status; and the construction site and equipments circumambience be clean and smooth.

10、检查记录：检查完毕后，应记录检查过程、问题处理过程及相关数据。

10. Inspection Records: After all the inspections are finished, the processes for inspection and problem shooting as well as relevant data should be recorded.

11、在运行时须根据炉水化验情况定期进行排污；水位计须定期冲洗并定期校核就地水位计与远程显示是否一致；安全阀须定期手动排气以校核阀芯的灵活性。同时做好各项纪录。

11. The boiler should be blown down during operation regularly based upon the water assaying results. The hydraulic gauge should be flushed as scheduled and checked for the conformity with the local hydraulic gauge and the remote indication. The relief valve must be turned on to exhaust the air manual on a regular basis to verify the flexibility of the valve spool. Meanwhile, all relevant records should be kept.

12、及时记录各项运行参数。

12. All the operating parameters should be recorded timely.

13、一切检查就绪后才允许启动点火。冷态启动时应缓慢升燃烧负荷，随时关注锅炉的膨胀状况，避免升温过快造成局部不均而产生应力，从而损坏锅炉。同时还应关注过热器的温度，避免过热器超温损坏。冷态启动时间一般不低于 90 分钟。

13. When all inspections are finished, ignition process can then be started. During cold start, combustion load should be increased slowly, with special attention given to boiler’s expansion, avoiding the stress resulting from local non-uniform heating caused by over-speeding temperature rise and finally the damages to the boiler. Meanwhile, attention should also be given to the temperature of super-heater, preventing damages to the super-heater by excess temperature. The cold starting time usually lasts over 90 minutes.

二、停炉保养

ii. Furnace Blow-out & Maintenance

本锅炉停炉保养采用干法保养或湿法保养均可。

This boiler can adopt either dry or wet preservation for furnace maintenance after blow-out.

1）干法保养（适用于长期停用）：首先在停炉保养前，应将炉水全部排空。其次，开启所有人孔、手孔，清除水垢和污物后，用小火来烘炉，使炉内的存水蒸发。第三、将盛有干燥剂的无盖铁盒或其它容器四个放在上下锅筒的封头处，将所有门、孔关闭严密，防止空气进入，一定要注意各门孔的严密性，否则，会因泄漏而影响生干燥剂的吸潮效果，甚至达不到防腐的目的。干燥剂量一般采用无水氯化钙或

生石灰，用量按每立方米锅炉容水，加 1~2Kg 无水氯化钙或 2~3Kg 生石灰计，每隔 2 个月应打开检查一次，发现干燥剂吸潮失效应立即更换。

1) Dry Preservation (applicable for furnace to be stopped for a long time): Prior to furnace blow-out maintenance, the furnace should be drained empty. Then open all the manholes and hand holes, clean away the water scale and sewage, and dry the boiler at mild fire to evaporate all moisture inside. After that, put four lidless iron boxes or other containers holding desiccant on the head plates of steam and water drums, and shut down all the doors and holes tightly to prevent air coming in. The air-tightness of each door/hole must be guaranteed; otherwise the moisture absorption performance of the desiccant may be affected due to leakage, and even the antiseptic objective may fail. The desiccant usually uses anhydrous calcium chloride or calcined lime, and its dosage is 1-2kg for anhydrous calcium chloride or 2-3kg for calcined lime per cubic meter. Those doors or holes should be opened every two months for inspection and the desiccants should be replaced with new ones when they are found losing the moisture absorption ability.

若不用干燥剂，也可以采用充氮气保养，维持在一定的压力。

Where desiccant is not to be used, nitrogen can be injected for such maintenance and maintained at a specific pressure.

2）湿法保养（适用于短期停用）：停炉后首先将锅炉受热面的内外污垢、烟灰清理干净，堵截与外界相连管路。其次将锅内灌满软化水，并在每吨水中加入 2kg 氢氧化钠或 5kg 磷酸三钠，或 10kg 磷酸钠，药品应溶解成溶液后灌入。当锅内灌满软水和药液后，应加热至 104℃，以排除水中的气体。然后将锅炉所有门孔关闭严密，且不得有任何渗漏现象。保养期间，锅炉必须保持充满状态，防止空气漏入。

2) Wet Maintenance (applicable for furnace to be stopped for a short time): After the furnace blow-out, clean away the smudges and smoke ashes on the heating surface and jam the pipeline that leads to the outside. Then fill the boiler full with softened water, and add 2kg NaOH or 5kg Na_3PO_4, or 10kg Na_3PO_3 per ton of water. The added chemical should be prepared into solution before poured in. When the boiler is filled with softened water and chemical solution, it should be heated up to 104℃ to exhaust the air contained in the water. After that, all the doors and holes should be sealed, and nor leakage should be permitted. During maintenance term, the boiler should be full of solution, preventing air leakage.

Ⅳ、锅炉经济运行管理

IV. Operating Instructions for Electric Controls

1、锅炉安装应符合设计要求，并符合 GB50273-2009《锅炉安装工程施工及验收规范》的要求。

2、锅炉给水符合应水质标准要求，严格按照要求进行给水除氧及给水加药、炉水加药处理，预防水垢生成，保证锅炉安全经济运行。

3、锅炉及其附属设备和热力管道的保温应符合 GB/T4272-2008《设备及管道保温技术通则》的要求，选用合理的保温厚度，减少散热损失。

4、锅炉运行时，应经常检查管道、仪表、阀门及保温情况，确保其完好、严密，及时消除跑、冒、滴、漏等情况。

1, Boiler installation should comply with the design requirements, and in accordance with GB50273-2009 boiler installation engineering construction and acceptance specification requirements.

2, Boiler feed water shall meet the water quality standard requirements, in strict accordance with the requirements of the feedwater and boiler water treatment, water chemical dosing, prevent scale formation, and ensure the safe and economic operation of the boiler.

3, Boiler and its auxiliary equipment and heat piping shall be in accordance with GB/T4272-2008 ***Equipment and pipe insulation technology rules*** requirement, choose the thickness of insulation reasonable, to reduce heat loss.

4, Boiler operation, should always check the piping, instrumentation, valves and heat insulation, ensure its integrity, rigor, eliminate run, take, drop, leakage and so.

Ⅴ、电控操作说明

V. Operating Instructions for Electric Controls

一、开机例行检查

i. Routine Inspections during Boiler Startup

电源 供电电压三相 380±20 VAC 50±1HZ 电压正常,容量足够。

Power Supply **Three-**phase 380±20 VAC, 50±1HZ, normal voltage, sufficient capacity

环境 控制机房应干燥通风,环境温度小于 40℃，相对湿度小于 90％，无腐蚀和破坏绝缘的气体与尘埃。

Environment The computer room should be kept dry and ventilated, with ambient temperature below 40℃ and relative humidity below 90%. No corrosion and air and dust that may damage the insulating protection are allowed.

绝缘 各动力设备及电控柜使用 500V 兆欧表检测，绝缘电阻应不小于 100MΩ

Insulation Each dynamic equipment and electric-control cabinet should be inspected by 500V ohm meter, and their insulation resistance should not be less than 100MΩ.

接地 电控柜、启动锅炉等须用扁铁与地网焊接，也可由低压配电间电缆接入，要求接地电阻小于 4Ω, 且连接可靠。

Grounding The electric-control cabinet and startup boiler should be welded to the ground mat by band iron or through the electric cable of low-voltage distribution box, whose ground-resistance should be below 4Ω and reliably earthed.

二、启停顺序及控制流程

ii. Start-stop Sequence & Control Procedure

1、启动前准备工作

1. Preparations before Startup

1） 合上动力电源及控制电源。

1) Turn on the dynamic power and the control power.

2） 将动力柜转换开关转向*手动* 档，单机试运转。确保单机无故障后，将转换开关转向*自动* 档；如单机存在故障或无法正常运行，将转换开关转向*停止* 档，并及时排除故障。

2) Turn the changeover switch on the power cabinet to “Manual” position and start commissioning at single

unit. When it is verified that the single machine has no fault, turn the changeover switch to “Auto” position. However, where the single machine does have any fault or cannot run normally, turn the switch to “Stop” position and get rid of the fault immediately.

3） 检查各调节阀，有无手轮转动阻滞。

3) Check all the control valves if there is any feeling of hindrance when turning wheel.

4） 检测各传感器信号，在 PLC 负载端信号电压应为 1～5V DC。如果信号电压不在此范围内，则存在故障，及时检查传感器有无损坏或信号电缆是否断开。

4) Check the sensors’ signals and make sure that the signal voltage at the PLC loading terminal is 1-5V DC. Where signal voltage doesn’t fall within this range, there must be some fault. In this case, inspection should be given to the sensor for any damage or the signal cable for any disconnection.

5）打开上汽包、过热器及相关管道上的排气阀。便于锅炉启动后排除空气。

5) Turn on the exhaust valves on the steam drum, super-heater and relevant pipeline for the purpose to exhaust air after boiler startup.

2、冷态运行模式

2. Cold Operating Mode

启动锅炉初次运行，系统预设定为冷态模式。

For the first operation of startup boiler, the system is pre-set in cold operating mode.

运行前需预先给启动锅炉给水至略高于危险水位。

Before operation, the startup boiler should be fed with water to a height slightly over the LL water level.

2.1 动力设备

2.1 Dynamic Equipment

启动送风机，稳定运行。

Start the draught blower and keep it running stably.

2.2 给水系统

2.2 Water Feeding System

如果运行过程中需要补水，建议手动启动给水泵和调节给水手阀，控制给水压力为 1.6MPa；水位控制在-5cm 左右。

Where make-up water may be required during operation, it is recommended to start the water-feed pump and regulate the water-feed valve manually. The water feed pressure should be maintained at 1.6MPa, and the water level be at -5cm.

2.3 燃烧系统

2.3 Combustion System

2.3.1 一切准备就绪，检测正确无误后，启动燃烧器，自动检测燃烧器器件，开启风门进行预吹扫。

2.3.1 When everything is set and the inspection gives reassuring results, then the burner can be started to actuate the automatic inspection over all the parts and components of the burner. Open the air damper to start pre-purging.

2.3.2 燃烧器风门回至点火位置，启动高能点火装置，产生高能电弧。约 1 秒钟后，自动打开燃料阀及调节阀门，向炉膛内喷射燃料，并由电弧直接点燃。电弧产生 15 秒钟后自动关闭点火装置。这时若火焰检测装置检测不到火焰，将自动关闭燃料阀，并报警。这时应检查三方面的装置：点火装置是否有电弧产生；燃料喷射是否正常；风量是否合适（偏大或风门关闭）。排除故障后才允许再次点火，两次点火的间隔时间应在 2 分钟以上，否则可能会产生爆燃现象。

2.3.2 Turn the burner air damper to ignition position and start the high-energy ignition device to generate high-energy electric arc. 1 second later, the fuel valve and the control valve will be started automatically to inject fuel into the furnace chamber, and the fire will then be ignited directly by the arc. The ignition device will be closed 15 seconds after the generation of electric arc automatically. If the flame detector cannot detect the flame, the fuel valves will be shutdown automatically with the company of alarming indication. In such case, the following devices should be inspected: check if the ignition device generates any electric arc; fuel is injected normally; and the input air is proper (i.e. the air damper is too much opened or closed). Only when the relevant default is eradicated, can ignition be initiated once again. The interval between two ignitions should be above 2 seconds, otherwise explosion may take place.

2.3.3 手动设置燃烧最大负荷，如果最大燃烧负荷为 0，则不开大风门；同理，风门最大开大至设定的最大负荷。

2.3.3 Set the maximum combustion load manually. If the maximum combustion load is 0, it is unnecessary to open the air damper; likewise, if in contrary, the air damper should be opened to the fullest extent corresponding to the maximum combustion load set in advance.

2.3.3 根据蒸汽压力传感器测量值和设定值（1.3MPa），PID 运算调节通过负荷选择开关送出大小火控制信号，燃烧器自动调节燃气与空气量，改变主火大小，实现负荷调节。对于突变情况，由于 PLC 反映滞后，操作人员可以根据用户实际使用蒸汽的情况，人工进行负荷的调节。

2.3.3 PID calculates and regulates based upon the measured value given by the steam pressure sensor and the set value (1.3MPa), and send the large or small fire signal. The burner can automatically adjust the gas and air quantity, change the main fire size and realize the load regulation. For unusual conditions taking place due to PLC response lag, the operator can regulate the intensity manually based upon the actual use of steam by the user.

2.4 烟风系统

2.4 Fume System

2.4.1 燃烧器风门吹扫时，风门开度控制在 33%～35%，配合吹扫，使炉膛内残余烟气吹扫干净。

2.4.1 During air purging by opening the burner’s air damper, the opening size of damper should be maintained between 33% and 35%. By doing so and combined with air purging, the residual fume remaining in the furnace chamber can be purged clean.

2.4.2 延时 90 秒后，风门开度回位在 19%～20%，准备点火。

2.4.2 After a 90s-time delay, the opening size of the air damper will return to 19%-20% and ignition can be started at this moment.

2.4.3 点火成功后，判断风门是否有增大趋势，若有则以每两秒开大 1%方式，与燃烧器风门同步开大，保证炉膛压力维持在一定范围内。

2.4.3 When the boiler is ignited successfully, it is necessary to determine whether the air damper tends to increase its opening size. If it is so, the angle actuator should be opened by 1% every two seconds simultaneously relative to the burner air damper to ensure the pressure inside the furnace chamber maintained in a certain range.

2.5 蒸汽减温系统

2.5 Steam De-super-heating System

待锅炉上压到 0.1MPa 后，冲洗各仪表管路。关闭各排气阀，逐渐打开过热蒸汽紧急排空门，使过热器得到充分冷却，确保过热器的安全。

Flush all the instrument pipelines when the boiler increases its pressure up to 0.1MPa. Shut down the exhaust valves, turn on the super-heated steam emergency exhaust valve to cool down the super-heater and ensure its safety.

本设备蒸汽温度的调节采用喷水减温的方式。根据所检测的过热蒸汽温度发展趋势，自动投入减温水，经喷嘴喷入减温集箱。通过减温水调节阀门的调节，确保蒸汽温度在允许范围内。也可采用手动方式调节减温水调节阀。

The regulation of steam temperature for this boiler uses spraying method for de-super-heating. Cool water will be sprayed into the de-super-heated header through the nozzles, based upon the super-heating steam temperature growth trend as monitored. By regulating the control valve for de-super-heating, the steam temperature can be maintained within the permissible range. As an alternative, the control valve for de-super-heating can also be regulated manually.

3、热态运行模式

3. Hot Operating Mode

系统预设定为冷态模式，如果锅炉处于热态，可选择热态直接启动。热态时由于锅炉各部件得到预热，可以缩短前期运行时间。

The pre-set mode of the system is cold mode. Where the boiler is set in hot mode, hot startup can be applied directly. During hot mode, operation time at earlier stage can be shortened due to the pre-heating to all parts and components of the boiler.

3.1 动力设备

3.1 Dynamic Equipment

启动送风机，稳定运行。

Start the draught blower and keep it running stably.

3.2 给水系统

3.2 Water Feeding System

3.2.1 在补水水位启动给水泵，且给水泵常开。

3.2.1 Start the feed-water pump at the make-up water level. This pump has to be turned on frequently.

3.2.2 在正常水位停止给水泵。

3.2.2 Stop the feed-water pump at normal level.

3.2.3 给水调节阀控制：根据水位压差变送器测量值和设定值（20mm），PID 运算调节给水阀开度的变化量。水位测量值略小于设定值（20mm），给水调节阀每秒开大开度的变化量；水位测量值略大于设定值（20mm），给水调节阀每秒关小开度的变化量。

3.2.3 Feed Water Control Valve: Based upon the measured value given by the water level differential pressure transmitter and the set value (20mm), PID calculates and regulates the opening size variation rate of the feed water valve. If the water level measured value is slightly lower than the set value (20mm), the feed water control valve will increase its opening size variation rate at every second; if in contrast, the opening size variation rate

will be reduced at every second.

3.3 燃烧系统（与冷态相同）

3.3 Combustion System (some to that in cold mode)

3.4 烟风系统（与冷态相同）

3.4 Fume System (some to that in cold mode)

3.5 蒸汽系统

3.5 Steam System

3.5.1 蒸汽压力测量以高温型压力传感器为核心，调节燃烧负荷火力。

3.5.1 The measurement of steam pressure regulates the combustion load based upon the high-temperature pressure transmitter.

3.5.2 调节减温水调节阀，控制蒸汽温度在（350℃）左右。

3.5.2 Regulate the de-super-heating water control valve to maintain the steam temperature at approximately 350℃.

3.5.3 主蒸汽电动门开启和关闭由用户手动操作。

3.5.3 Main steam electric door is opened or closed manually.

3.5.4 当过热器蒸汽压力大于设定值，紧急排空电动门自动开启；当过热器蒸汽压力小于规定的设定值，紧急排空电动门自动关闭。

3.5.4 When the steam pressure in super-heater is larger than the set value, the emergency exhaust electric valve can be opened automatically. Likewise in contrast, the valve will be shut off in an automatic way.

3.5.5 若没有打开主蒸汽电动门，则须开启紧急排空电动门，以确保过热器的安全。

3.5.5 Where the main steam electric valve is not opened, the electric emergency exhaust valve must be opened to ensure the super-heater’s safety.

4、停止燃烧、待机及重启

4. Combustion Stop, Standby and Restart

4.1 当蒸汽压力大于最高设定压力时，断开燃烧器启停信号，停止燃烧。

4.1 When the steam pressure is higher than the highest set value, the burner start-stop signal will be put in open state and the combustion will be stopped.

4.2 当蒸汽压力低于设定压力值时，闭合燃烧器启停信号，重新启动燃烧。

4.2 When the steam pressure is lower than the set value, the burner start-stop signal will be put in closed state and the combustion will be restarted.

4.3 也可以根据电厂蒸汽使用的实际情况，操作人员手动进行操作，或重新设定运行参数。

4.3 The operator may, on the basis of actual application of steam in power plant, to operate manually or re-set the operating parameters.

5、停机顺序

5. Boiler Stop Sequence

5.1 停止燃烧。关闭进油阀门，切断燃料供应系统。

5.1 Stop combustion. Shut down the oil inlet valve, and cut off the fuel supply system.

5.2 停止给水系统，关闭给水调节阀，给水自动停止。

5.2 Stop the water feeding system, shut down the feed water control valve. Then the water stops feeding automatically.

三、联锁保护及故障处理

iii. Interlocking Protection & Troubleshooting

1、动力设备

1. Power Unit

1.1 送风机过载：送风机保护不启动，联锁燃烧系统停止；自动给水系统不运行；蒸汽无法产生。声光报警输出，需复位送风机热继电器。

1.1 Draught blower is overloaded: the draught blower cannot be started and the interlocking combustion system stops; automatic water-feeding system stops; and the steam cannot be generated. The acousto-optic alarming indicator is output, indicating the reset of the thermo-relay of the draught blower.

1.2 给水泵过载：给水泵保护不启动，联锁燃烧系统停止；自动给水系统不运行；蒸汽无法产生。声光报警输出，需复位给水泵热继电器。

1.2 Feed-water pump is overloaded: the protective device of the feed-water pump cannot be started and the interlocking combustion system stops; automatic water-feeding system stops; and the steam cannot be generated. The acousto-optic alarming indicator is output, indicating the reset of the thermo-relay of the feed-water pump.

2、给水系统

2. Feed Water System

2.1 运行中发生危险水位，系统将停机；声光报警输出，需及时查看给水系统。

2.1 In case of LL water level during operation, the system will stop. The acousto-optic alarming indicator is output, indicating that the water feeding system should be inspected immediately.

2.2 发生超高水位，系统将继续运行，但声光报警输出，提示司炉人员及时排水。

2.2 In case of HH level, the system will continue running, but the acousto-optic alarming indicator is output, indicating that the stoker should drain the furnace immediately.

3、燃烧系统

3. Combustion System

如果燃烧器件损坏、点火不成功，燃烧程控器红灯亮，将无法燃烧。待排除故障后，再人工复位燃烧程控器。

If the burner has any component or the ignition fails, the remote combustion control indicating light will turn red and combustion will stop. When the fault is eradicated, manual resetting is required for the remote combustion control.

4、蒸汽系统

4. Steam System

蒸汽压力控制器超压保护，系统将停机，声光报警输出。需紧急处理。

When the protective device of steam pressure control is triggered due to overpressure, the system will stop and the acousto-optic alarming indicator is output, indicating that emergency handling is required.

四、触摸屏（或上位机）操作

iv. Operations on Touch Screen (or Hoist Computer)

我司根据锅炉的各系统及相关参数在操作界面上均进行了设置，并有明确提示。操作人员在正式操作前应进行熟悉，并根据操作界面的提示进行操作。

Systems and relevant parameters on the operational interface have all been set before boiler delivery and are provided with express indications. Operators should be familiar with these operations and know how to operate the boiler based upon these indications before the boiler runs official.